



## Original communication

## Heterogeneity of existing research relating to sexual violence, sexual assault and rape precludes meta-analysis of injury data



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## ABSTRACT

In order for medical practitioners to adequately explain to the court the findings of their clinical examinations of victims of sexual violence, they must have access to research data which will place their findings in to context. Unfortunately, existing research has reported a very wide range of injury prevalence data. This paper aims to provide an explanation for this wide variation in results and, furthermore, this paper aims to establish if it is possible to carry out a meta-analysis of existing research data, pertaining to the prevalence of injury after sexual assault. It is suggested that pooling of individual study results may allow statistically robust determination of the true prevalence of injury in victims of sexual violence. It is concluded that heterogeneity in research methodology, between existing research studies, is responsible for the broad range of reported prevalence rates. Finally, this heterogeneity is seen to preclude robust meta-analysis.

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## 1. Introduction

Clinical forensic examination of the sexual assault victim has two primary aims. First and foremost, the examination serves the immediate medical needs of the victim in terms of treatment of injury, prevention of infection and so forth. In addition to this, the medical practitioner aims to identify and carefully record the nature and extent of all injuries so that an accurate report can be provided to the investigating police officers and to the court. In order to compile an effective clinical forensic examination report, the medical practitioner must be able to set his/her findings in context with those which might be expected in such a case. One of the most important questions that a medical practitioner may be asked in court is to provide an estimate of the likelihood of victim injury being present in a particular case. This question can only be answered if reliable data pertaining to the prevalence of injury is available. However, it is widely accepted that available research, which has addressed the

incidence of injury after sexual violence, presents a very broad range of prevalence estimates for both genital and general body injury.

## 2. Aim

This paper aims to establish an explanation for the broad range of prevalence estimates provided by existing research. In addition, this paper aims to establish if it is possible to carry out a meta-analysis of existing research data pertaining to the prevalence of injury after sexual assault. Whilst individual studies are frequently under-powered in their ability to robustly determine the prevalence of injury with statistical rigor, it is postulated that meta-analysis of studies will allow determination of a statistically significant prediction. This may facilitate medical practitioners in explaining the significance of their clinical examination findings.

## 3. Methods

## 3.1. Literature search

A systematic search of the international literature was performed with a view to identifying injury prevalence data. Preliminary pilot searches suggested that the research literature in this area was

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**Table 1**

A description of the methodologies employed by existing research and a summary of available prevalence data.

Author	Year of publication	Primary aim	Study setting	Grade performing examination	Study population <i>n</i> =	Examination technique	General body injury %	Genital injury %	No injury %	Comments
Alempijevic, Savic, Pavlekic and Jecmenica.	2007	To determine specific characteristics and severity of injuries among victims of sexual violence	Unclear.	"Mostly gynaecologists... in few cases was a specialist in forensic medicine involved".	113	n/a	63.4		35.6	Did not look at genital injuries.
Biggs, Stermac and Divinsky.	1998	To document the type and site of genital injuries from sexual assault in women without and with prior sexual intercourse experience.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Specifically trained forensic doctor.	66 66	Direct visualisation alone. No colposcopy. Staining not reported in methodology.		65.2 25.8		Virgins Non-virgins Did not look at general body injury.
Bowyer and Dalton.	1997	To ascertain the incidence of genital injury in victims of alleged rape.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Specifically trained forensic doctor.	83	Direct visualisation alone. No colposcopy or staining.	82	26.5	18	Routine follow-up exam 1–2 days after first.
Cartwright, Moore, Anderson and Brown.	1986	To see if sustaining injury to the genital area was an inevitable consequence of being raped.	Hospital.	Gynaecology house officer.	440	Direct visualisation alone. No colposcopy or staining.	41	16		Important article because of attempts to correct data to avoid reporting bias.
Cartwright and the sexual assault study group.	1987	To identify factors that correlate with injury sustained by survivors of sexual assault.	Hospital.	Second, third and fourth year gynaecology house officers trained in the medico-legal examination of victims of sexual assault.	405	Direct visualisation alone. No colposcopy or staining.	40	16	"approximately half of victims". Percentage not specified.	

Everett and Jimerson.	1977	“Review of 117 consecutive cases”	University Hospital. No further specification.	“personal physician”.	117	Direct visualisation alone. No colposcopy or staining reported in methodology.	44	26	35.9	
Gray-Eurom, Seaberg and Wears.	2002	To determine the association between historical and physical evidence with judicial outcome in sexual assault cases.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Trained medical doctors and nurse examiners.	355 (345 female and 10 male)	Direct visualisation alone. No colposcopy. Staining not mentioned in methodology.	45	35	43	Note that the results of this study include 10 male victims in the total of 355 (i.e. 345 female victims). Note that the study enrolled 821 patients. 801 of these had an examination performed. However, the authors report examination findings only in cases where a suspect was identified by the police ( $n = 355$ ). Examined within 72 h Examiner after 72 h
Grossin, Sibille, Granmaison, Banasr, Brion and Durigon.	2003	To describe victim, assailant, assault characteristics for sexual assault victims according to the time between last sexual assault and the examination, and to provide descriptive data on medico-legal findings.	Hospital based “Department of Forensic Medicine”.	Doctors with specialist training in forensic medicine.	161 221 (total: 418; 36 excluded; 382 included in analysis).	Direct visualisation and colposcopy. Staining not mentioned in methodology.	39.1 6.3	35.7 19.5		
Hayman, Lanza, Fuentes and Algor.	1972	To summarise the experience with female alleged victims from July 1, 1969 through December 31, 1970.	Hospital.	Not specified.	1223	Direct visualisation alone. No report of the use of colposcopy or staining.	22.7	17.9		

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Table 1 (continued)

Author	Year of publication	Primary aim	Study setting	Grade performing examination	Study population <i>n</i> =	Examination technique	General body injury %	Genital injury %	No injury %	Comments
Hilden, Schei and Sidenius.	2005	To evaluate the presence and extent of genitoanal injury among sexually assaulted women and to estimate the risk of injury in subgroups according to the type of assault and to the sexually assaulted women's susceptibility to injury.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Gynaecologist (+forensic pathologist only in cases reported to police).	249	Direct visualisation alone.	59.4*	32	27.3*	*Not directly reported; obtained by secondary analysis of published study data. Both figures are approximate as data was incomplete for 6 victims.
Hwa, Chen, Wu, Shun, Liu, Lee and Chen.	2010	To describe the characteristic of the victims, assaults, and associated physical and psychologic trauma of sexual assault cases in Taipei.	Emergency Department.	Gynaecologic, urologic, surgical or psychiatric resident on duty in the ED, under the guidance of responsible staff.	114* [males: 7; female: 107]	Direct visualisation alone. No colposcopy or staining.	41 [males: 28.6; females: 41.8]	53.3 [males: 57.1; females: 53.1]	27.6	*Includes 7 males along with 107 females. Gender-specific data is presented in parenthesis.
Lauber, Micki and Souma.	1982	Report on the use of Toluidine Blue for recognition of genital trauma in women experiencing consenting or non-consenting intercourse.	Emergency Department for non-consensual group.	Gynaecologist or family practice resident physician	22	Toluidine blue staining used on all victims.		40		

Lenahan, Ernst and Johnson.	1998	To determine if the colposcope improves detection of genital trauma in adult women who are victims of sexual assault compared with gross visualisation alone.	Emergency Department.	Emergency resident on call with training in sexual assault examinations.	17	Colposcopy on all victims. Staining not mentioned.	76	53	Note small study population. Gross visualisation alone found genital trauma in only 1 patient.
McCauley, Guzinski, Welch, Gormal and Osmer.	1987	To evaluate the use of toluidine blue in the corroboration of rape in the adult victim and comparison with patients examined after consensual intercourse.	Emergency Department.	Gynaecology and emergency room residents.	24 [48]	Toluidine blue staining. Colposcopy not mentioned in methodology.		58 [10]	Non-consensual Consensual Did not look at general body injury.
McGregor, Du Mont and Mhyr.	2002	To describe the medico-legal findings in a population of adult sexual assault cases assessed in an emergency department setting and reported to the police. To document the law enforcement and legal disposition of cases seen over the study period. To determine whether medical-legal findings are associated with filing of charges and conviction after adjusting for demographic and assault characteristics.	Emergency Department based Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Trained medical doctors and nurse examiners.	462	Direct visualisation alone in most cases. Colposcopy in a small minority.		41.8	<b>Inconsistent examination technique:</b> Colposcopy was performed on a small number of victims (7.6%). Did not look at general body injury.

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Table 1 (continued)

Author	Year of publication	Primary aim	Study setting	Grade performing examination	Study population <i>n</i> =	Examination technique	General body injury %	Genital injury %	No injury %	Comments
McLean, Roberts, White and Paul.	2011	To compare the incidence of genital injury following penile-vaginal penetration with and without consent.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Specifically trained forensic doctor.	500 [68]	Direct visualisation with standard magnification. No colposcopy or staining.		22.8 [5.9]		Non-consensual [Consensual] Did not look at general body injury.
Palmer, McNulty, D'Este and Donovan.	2004	To determine the type, frequency and severity of genital and non-genital injuries of women following alleged sexual assault and, in addition, to determine factors associated with the presence of injuries.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Specifically trained forensic doctor.	153	Direct visualisation alone. No colposcopy or staining.	46	22	52	
Rambow, Adkinson, Frost and Peterson.	1992	To assess the medical and legal effectiveness of this institution's existing adult female sexual assault protocol.	Hospital based Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Unclear.	182	Direct visualisation and "photography" of injuries. Colposcopy and staining not specifically discussed in methodology.		9	50	
Ramin, Satin, Stone and Wendel.	1992	To examine patient characteristics, patterns of injury, forensic evidence, and the frequency of sexual assault in postmenopausal rape victims.	Hospital.	Obstetrician-gynaecologist.	129 129	Not specified. Assumed to be direct visualisation alone.	49 66	43 18	33* 29*	Postmenopausal Premenopausal *Derived by secondary analysis of published data.

Riggs, Houry, Long, Markovchick and Feldhaus.	2000	To describe victim, assailant, assault and treatment characteristics for sexual assault victims and to provide descriptive data on the evidentiary examination.	Emergency Department.	Emergency medicine resident on duty.	1076 <sup>^</sup> [males: 41; females 1035]	Direct visualisation alone. No colposcopy or staining.	67	53	20.4	<sup>^</sup> Includes 41 males along with 1035 females. Gender-specific data is not presented.
Satin, Hemsell, Stone, Theriot and Wendel.	1991	To examine patient demographic, forensic evidence and patterns of injury in pregnant victims compared with 114 matched non-pregnant victims and to compare pregnancy outcome with that of the Parkland Memorial Hospital obstetric population.	Emergency Department.	An attending physician.	114 114	Direct visualisation alone assumed. Colposcopy and staining not mentioned in methodology.	39 54	5 24	57 27	Pregnant Non-pregnant
Slaughter and Brown.	1992	To report experience of the use of colposcopy in rape victims	Hospital with SATU/SARC equivalent.	Trained medical doctors and nurse examiners.	131	Colposcopy and toluidine blue on all victims.	55	87		
Slaughter, Brown, Crowley and Peck.	1997	To compare types and patterns of injury in sexual assault victims against those after consensual intercourse	Hospital with SATU/SARC equivalent.	Trained medical doctors and nurse examiners.	311 [75]	Colposcopy on all victims.		68 [11]		Non-consensual Consensual Did not look at general body injury.

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Table 1 (continued)

Author	Year of publication	Primary aim	Study setting	Grade performing examination	Study population <i>n</i> =	Examination technique	General body injury %	Genital injury %	No injury %	Comments
Sugar, Fine and Eckert.	2004	To determine characteristic associated with physical injury in female sexual assault victims	Emergency Department.	Second or third year residents in obstetrics and gynaecology with specific training in sexual assault examinations.	819	Colposcopy was used only to document grossly visible genital trauma. Staining not mentioned.	52	20	41	
Tintinali and Hoelzer.	1985	To identify patterns of medical findings in sexual assault, to investigate the appropriateness of medical therapy and to determine the impact of the emergency department examination on the legal process.	Emergency Department based Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Emergency physician.	372	Direct visualisation alone. No colposcopy or staining mentioned in methodology.		23.5*	68	*Approximate figure as genital injuries may have been counted twice in secondary analysis of this papers' reported data (if patient had both a "mild" and/or "moderate" and/or "severe" injury). Did not look at general body injury.
White and McLean.	2006	To compare findings in virgin and non-virgin adolescents attending a sexual assault referral centre.	Sexual Assault Treatment Unit (SATU or SARC) or variant of same.	Specifically trained forensic doctor.	224	Not specified. Assumed that colposcopy was used on the basis of UK setting.	50.9	40.2		Data refers to entire study group (virgins and non-virgins). Note study population of 12–17 year olds.
<b>Total</b>					<b>8385</b>					
<b>Minimum</b>					<b>17</b>		<b>6.3</b>	<b>5</b>	<b>18</b>	
<b>Maximum</b>					<b>1223</b>		<b>82</b>	<b>87</b>	<b>68</b>	
<b>Median</b>					<b>203</b>		<b>47.5</b>	<b>29.3</b>	<b>35.8</b>	
<b>Mean</b>					<b>299.5</b>		<b>48.6</b>	<b>34.8</b>	<b>38.4</b>	



limited in quantity, sporadic in timeline and widely dispersed in geographical origin. As such, a systematic search process was designed in order to ensure that as much of the available data was obtained in so far as possible. The following databases were searched: PubMed 1948 to present, Embase, Web of Science, Scopus V.4 (Elsevier) and the Cochrane Database of Systematic Reviews. A sample of the key search terms that were used includes “sexual assault”, “rape”, “injury”, “genital injury”, “trauma” and “genital trauma”. The search was limited to publications in the English language. Other exclusion criteria were studies that focused entirely on paediatric populations and studies that did not report any numerical injury data. Data was extracted from the included literature using a specifically designed data-extraction template. In addition to numerical data relating to injury prevalence, information pertaining to the study setting, the grade of examining clinician and the examination technique that was employed in the study was also recorded.

### 3.2. Meta-analysis

All data from the included research literature, which pertained to the prevalence of injury after sexual violence, was compiled and combined to produce global prevalence estimates for general body and genital injury.

## 4. Results

### 4.1. Characteristics of included studies

26 studies, which satisfied the inclusion criteria, were included in the meta-analysis. A synopsis of each study is provided in Table 1. The year of publication for the included studies ranged from 1972 to 2011.

### 4.2. Study aims

The studies varied significantly in terms of their primary aims, however most studies could be categorised in to three broad groups:

1. Studies that sought to profile the prevalence and/or type of victim injury<sup>1–10</sup>
2. Studies that sought to compare victim injury across different populations (e.g. virgins and non-virgins)<sup>11–16</sup>
3. Studies that reported injury data whilst describing the use of new examination equipment and/or technique<sup>17–20</sup>

However, several studies did not fit into these categories. One aimed to “see if sustaining injury to the genital area was an inevitable consequence of being raped”.<sup>21</sup> Another aimed to identify risk factors that were associated with victim injury.<sup>22</sup> Three studies sought to describe the relationship between victim injury and the progress of the case through the criminal justice system.<sup>23–25</sup> Tintinalli et al. sought to identify the appropriateness of the medical therapy provided to victims at their institution.<sup>25</sup> Finally, Rambow et al. aimed to evaluate the effectiveness of their institutions’ female sexual assault protocol.<sup>26</sup>

### 4.3. Study settings

Analysis of the settings in which each research study was conducted revealed that studies could be largely classified in to three groups. The majority of studies were conducted in a Sexual Assault Treatment Unit (SATU), Sexual Assault Referral Centre (SARC) or in another variant of this model of care.<sup>2,6,8,11,12,15,16,20,23–26</sup> Seven studies were based in an Emergency Department (ED).<sup>7,9,10,14,17–19</sup> In six papers, the research study was described as having been based in a hospital setting without further specification of the study

environment.<sup>3–5,13,21,22</sup> In one study the setting was not clearly described.<sup>1</sup>

### 4.4. Grade of examining clinician

In only half of studies was it specified that the examination was carried out by a nurse or doctor who had specialist training in the area of clinical forensic examination.<sup>2,4,8,10–12,15,16,18,20,22–24</sup> Of those studies which were conducted within a SATU or SATU variant, the majority of examining clinicians were described as having undertaken specialist training.<sup>2,8,11,12,15,16,20,23,24</sup> The grade of clinician varied between SATUs, with trained nurses undertaking examinations in some centres and doctors in others. In one study, a gynaecologist performed the examination alone in cases which were not reported to the police, but performed the examination in combination with a forensic pathologist in those cases that were reported to the police.<sup>6</sup> In another study, where the SATU was based within a hospital ED, the examination was performed by an Emergency Physician.<sup>25</sup>

Analysis of studies which were based in a setting other than a SATU or SATU variant revealed no clear pattern in the grade of examining clinicians. Gynaecology house officers performed the examinations in some studies.<sup>10,21,22</sup> It was not always specified if these doctors had specialist training in forensic gynaecology.<sup>21</sup> Emergency Department physicians were recorded as the examining clinicians in two other studies,<sup>9,18</sup> but in only one of these was it specified that the doctor had undertaken specialist training.<sup>18</sup> In a number of studies there was inherent inconsistency between the grades of examining clinicians. For example, in one study the examining clinicians were “mostly gynaecologists”, however “in a few cases was a specialist in forensic medicine involved”,<sup>1</sup> and in another study the examinations were performed by the “gynaecologic, urologic, surgical or psychiatric resident on duty in the ED, under the guidance of responsible staff”.<sup>7</sup> The term “responsible staff” was not explained in the publication. In another study, the examination was performed by the gynaecology or family practice resident physician.<sup>17</sup> In another study the grade of clinician was described as a “personal physician”.<sup>3</sup> In another study, the examining clinicians were described as doctors with specialist training in forensic medicine, which is a term that can have variable meaning from one country to another.<sup>4</sup>

### 4.5. Study size

The included research studies varied in size from 17 to 1223 study participants, with a mean study size of 299.5.<sup>1–26</sup> When all included studies were directly summated, the total combined sample size was 8385.

### 4.6. Examination technique

A classification of the included research studies, according to the examination technique employed is provided in Table 2, along with a brief description of the various examination techniques. The majority of studies involved a standard forensic gynaecological examination without the use of staining or magnification (i.e. “direct visualisation alone”). However, a significant number of studies deviated from this type of technique to include staining,<sup>17,19</sup> colposcopy<sup>4,16,18</sup> or staining and colposcopy in combination.<sup>20</sup> Several studies were not explicit in describing the examination technique that was used. It is not always clear whether or not colposcopy and/or staining were employed. Thus, whilst Table 2 attempts to classify studies according to examination technique, for a number of included studies the classification is based upon this author’s opinion of the examination technique that was most likely to have been employed, as suggested by other features of the published research article.

**Table 2**  
A classification of published research studies according to examination technique, adapted from Sommers et al. <sup>35</sup>. A description of each examination technique is also provided. The reported prevalence of genital injury for each study is provided in parenthesis.

Examination technique	Description	Applicable research studies (prevalence of genital injury)
Direct visual inspection	Standard gynaecological and forensic examination, unaided by magnification or staining techniques, but typically using additional illumination and a vaginal speculum.	Riggs, 2000 (53%) Bowyer, 1997 (26.5%) Cartwright, 1987 (16%) Everett, 1977 (26%) Sugar, 2004 (20%) Ramin, 1992 (30.5%) <sup>a</sup> Palmer, 2004 (22%) Biggs, 1998 (44.2%) <sup>b</sup> McLean, 2011 (22.8) Cartwright, 1986 (16%) Hayman, 1972 (17.9%) Rambow, 1992 (9%) Gray-Eurom, 2002 (35%) Tintinali, 1985 (23.5%) <sup>c</sup> Hilden, 2005 (32%) Hwa, 2010 (53.1%) <sup>e</sup> Satin, 1991 (14.5%) <sup>f</sup> Lauber, 1982 (40%) McCauley, 1987 (58%)
Staining techniques: gentian violet, Lugol's solution, toluidine blue, flurorscein	Staining can make abrasions and lacerations more visible to the naked eye.	
Studies using colposcopy and staining in combination		Slaughter, 1992 (87%)
Colposcopy	Used to illuminate, magnify and photograph external and internal genitalia.	Slaughter, 1997 (68%) Lenahan, 1998 (53%) Grossin, 2003 (27.6%) <sup>d</sup> White, 2006 (40.2%)

<sup>a</sup> Average of premenopausal and postmenopausal cohorts.

<sup>b</sup> Average of virgin and non-virgin cohorts.

<sup>c</sup> Approximate figure as genital injuries may have been counted twice in secondary analysis of this paper's published data (if patient had both a "mild" and/or "moderate" and/or "severe" injury).

<sup>d</sup> Average of examination before 72 h and after 72 h groups.

<sup>e</sup> Only data for female patients is presented.

<sup>f</sup> Average of pregnant and non-pregnant patients.

One study was excluded from this classification on the basis of inconsistent examination technique whereby the majority of study participants were examined by direct visualisation alone, but colposcopy was performed on a small number (7.6%) of patients.<sup>24</sup> The reported prevalence of genital injury in that study was 41.8%. Another study is not included on Table 2 because genital examination findings were not reported in the research article.<sup>1</sup>

#### 4.7. General body injury

The proportions of study participants with general body injury are outlined in Fig. 1. The mean prevalence of general body injury was 48.6%, with a range of 6.3 to 82% and a median of 47.4%. Eight included studies did not report the prevalence of general body injury and are therefore excluded from this analysis.

#### 4.8. Genital injury

The proportions of study participants with genital injury are outlined in Fig. 2. The mean prevalence of genital injury was 34.8%, with a range from 5 to 87% and a median of 29.3%. Only one study, which did not report the prevalence of genital injury, is excluded.

#### 4.9. No injury

The proportions of study participants without general body or genital injury are outlined in Fig. 3. Only studies that specifically reported data on the absence of injury and studies where this information could be extracted by secondary analysis of reported data are displayed. Thus, fifteen studies are excluded from this analysis.

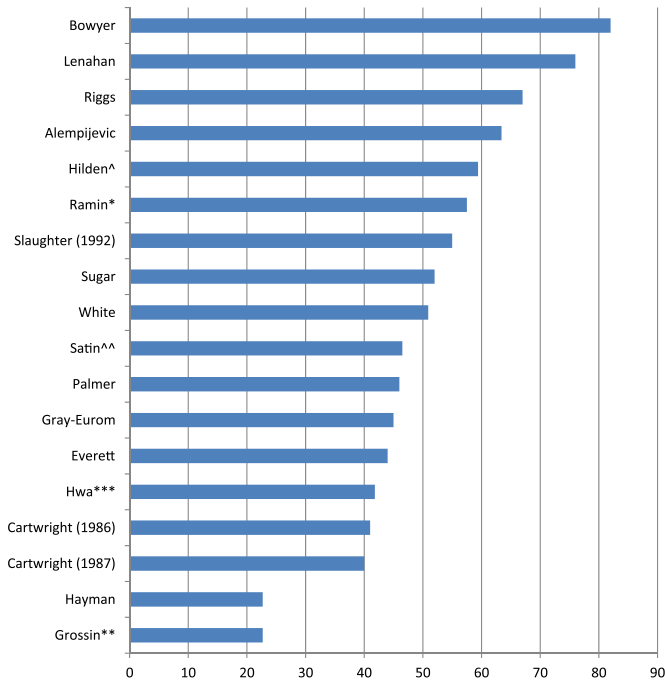
## 5. Discussion

### 5.1. Meta-analysis

This study demonstrates that heterogeneity in research methodology, between existing research studies, is responsible for the broad range of reported prevalence rates for general body and genital injury after sexual violence. The combination of data from existing research studies has suggested mean prevalence rates for general body injury and genital injury after sexual violence, based upon a much larger pool of patients. However, the statistical reliability of this meta-analysis is grossly undermined by the heterogeneity between individual research studies. Thus, the most striking finding of this study is the description of the heterogeneity of research methodologies that have been employed in a range of research studies pertaining to the prevalence of injury after sexual violence. This highlights a need for further observational research projects, with standardised methodology, in order to establish definitive prevalence data.

### 5.2. Heterogeneity of existing research

Variability in the characteristics of existing research studies, relating to injury after sexual violence, precludes performance of useful meta-analysis. In the first instance, studies reporting such prevalence data varied significantly in their primary research objectives, with only a minority of studies actually setting out to describe the prevalence of victim injury. The majority of included studies reported prevalence data as a by-product of the approach to answering another research question. Robust meta-analysis of prevalence data is ideally based upon compilation of research studies that address the same research question.

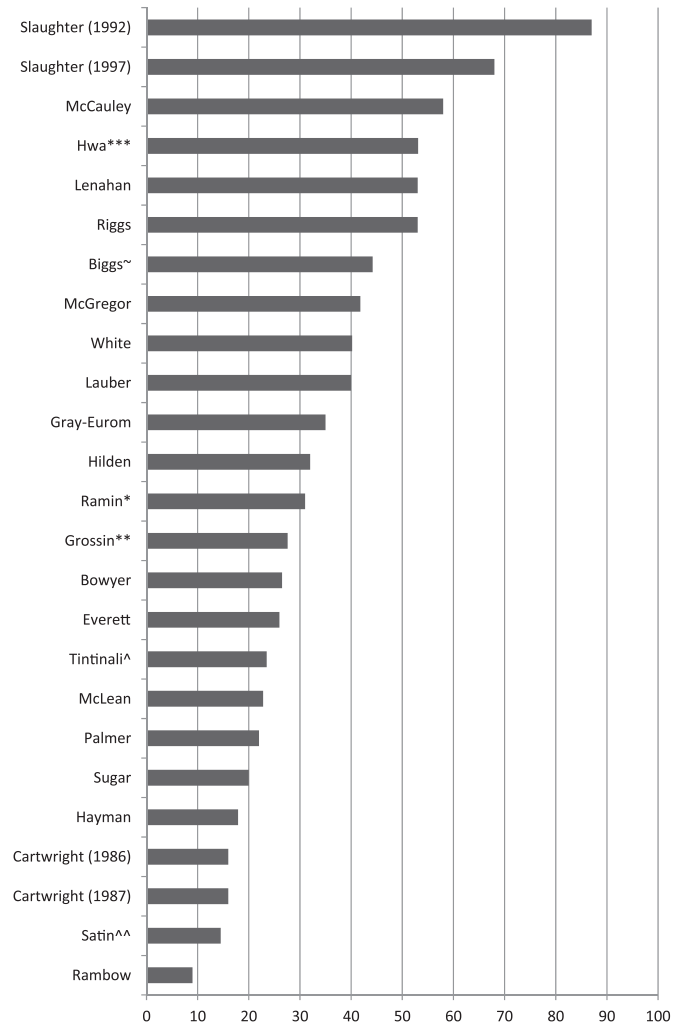


**Fig. 1.** Percentage of study participants with general body injury. \*Average of premenopausal and postmenopausal cohorts. ^This is an approximate figure based upon secondary analysis of the published data. \*\*Average of <72 h and >72 h cohorts. \*\*\*This study included 7 male victims. Data for female victims is presented. ^^Average of pregnant and non-pregnant cohorts.

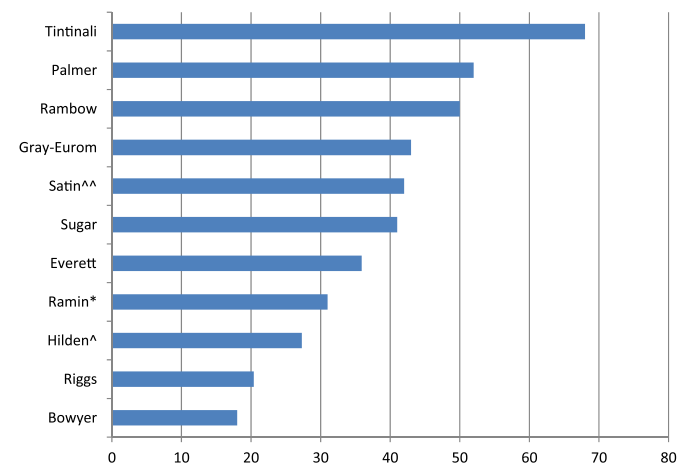
The clinical environment, in which physical and genital examinations were performed, and the grade of the examining clinician also varied between individual studies. Whilst the majority of studies were based in a SATU, or a variant of this model of care, many others were based in other clinical settings. This research demonstrates that the examining clinicians in existing studies differ significantly in terms of their clinical background. In addition to differing in terms of their clinical speciality, doctors also varied in terms of their level of training. Specialist forensic examination training had been undertaken by clinicians in half of the included studies. It is certain that clinicians with different training will bring different competencies to the clinical forensic examination and this in turn will influence their findings. The absence of uniformity between the clinical settings and the training of the examining clinicians prevents accurate summation of individual study results.

This compilation of existing research demonstrates that many studies reporting injury prevalence data are very small in size. Nine of the included studies had less than 150 patients involved,<sup>1–3,7,11,17–20</sup> and the overall mean study size was 299.5 patients. That so much existing research evidence is based upon small study samples underlines the potential significance of an accurate meta-analysis. If heterogeneity of study methodology precludes such an exercise, then further descriptive research, that includes a much larger sample size, is needed.

It can be seen from Table 1 that studies also differed significantly in terms of the prevalence data that they report. Several studies report either one of general body injury prevalence or genital injury prevalence, but not both. Half of studies failed to report the number of patients that were without any injury. On that issue, it is however noteworthy that the other half of included studies reported that a proportion of patients were without any injury.<sup>1–3,7–10,13,14,22,23,25,26</sup> This finding highlights the importance of ensuring all those who are involved in these cases, including medical professionals, legal professionals and police officers are all aware that



**Fig. 2.** Percentage of study participants with genital injury. \*Average of premenopausal and postmenopausal cohorts. ~Average of virgin and non-virgin cohorts. ^This is an approximate figure based upon secondary analysis of the published data. \*\*Average of <72 h and >72 h cohorts. \*\*\*This study included 7 male victims. Data for female victims is presented. ^^Average of pregnant and non-pregnant cohorts.



**Fig. 3.** Percentage of study participants without any general body or genital injury. Only studies that specifically reported data on the absence of injury and studies where this information could be extracted by secondary analysis of reported data are displayed. \*Average of premenopausal and postmenopausal cohorts. ^This is an approximate figure based upon secondary analysis of the published data. ^^Average of pregnant and non-pregnant cohorts.

injury is absolutely not a necessary outcome of sexual violence. The significance of this issue has recently been highlighted in the literature.<sup>27</sup>

Clinical examination technique has a key influence on the frequency of diagnosis of injury. Colposcopy can detect injury in up to 87% of patients<sup>20</sup> and has been shown to be statistically superior to gross visualisation alone.<sup>18</sup> Toluidine blue staining also increases the frequency of diagnosis of genital injury.<sup>19</sup> The present study describes significant variation between existing research in terms of clinical examination technique. Whilst the majority of studies involved a standard forensic gynaecological examination without the use of staining or magnification (i.e. “direct visualisation alone”), a significant number of studies deviated from this type of technique to include staining,<sup>17,19</sup> colposcopy<sup>4,16,18</sup> or staining and colposcopy in combination.<sup>20</sup> Several other studies failed to adequately describe the examination technique that was utilised. It is not appropriate to compile results from existing research where the examination techniques are so variable. When placing clinical examination findings in context for the court, medical practitioners might consider confining themselves to referring to prevalence data reported in studies, the methodology of which, reflect their own clinical examination technique.

### 5.3. Limitations of existing research: self-reporting bias

Review of the published literature pertaining to victim injury after sexual crime reveals that one inherent limitation is common to the majority, if not all, of existing studies. Recruitment of patient populations in existing research studies is generally based upon self-reporting, by victims, of sexual crime. Given that it is known that the prevalence of false allegations in the area of sexual crime is in the region of 2–10%,<sup>28</sup> then basing research upon self-reporting populations may be skewing statistical analysis of injury data. Furthermore, it is known that victims are more likely to report sexual crimes when they have sustained injury.<sup>29,30</sup> If victim injury increases the likelihood of reporting sexual crime, then the true prevalence of victim injury after such crimes may be much lower than that which is estimated by existing research.

Efforts have been made to attempt to account for self-reporting behaviour. Cartwright et al. acknowledged this challenge and attempted to address it by studying the prevalence of injury in a subset of females reporting sexual crime who had both evidence of non-consent (i.e. general body injury) and evidence of vaginal penetration (i.e. sperm found in the vagina which not accounted for by consensual intercourse).<sup>21</sup> In this subset of 75 females, the prevalence of genital injury was 28%. This study also provides injury prevalence data for victims whose cases actually resulted in a rape conviction. Of 60 such cases, 17% had genital injury.

### 5.4. Limitations of this research

It is acknowledged that this research does not include all published research pertaining to injury data after sexual violence; however it is likely that the included studies are reflective of the overall body of literature in the field. Furthermore, it is acknowledged that the author has conducted secondary analysis of published data in the case of a small number of included studies. Such analysis is open to the possibility of error; however the over-riding conclusion of this research, that heterogeneity precludes meta-analysis, would not be compromised by such error.

### 5.5. Implications for future research and clinical practice

The present study identifies a number of future research themes, progress in which would inform clinical practice in the care

of victims of sexual violence. In the first instance, it is noteworthy that a search of the international literature, which sought to identify research pertaining to injury after sexual violence, yielded very limited information relating to male victims.<sup>7,9,31</sup> There is a clear imbalance in the proportion of existing research that is dedicated to female victims of sexual crimes. Males are known to have a high incidence of rape.<sup>32</sup> Whilst there is a growing body of research evidence in relation to female sexual assault, there is a clear paucity of literature relating to the male equivalent. This finding should be highlighted to academics working in the field so that efforts to rectify the deficit can begin. Recent advances in this regard are noted and welcomed.<sup>33</sup>

This research study represents the first published attempt at meta-analysis of injury data pertaining to sexual assault. It has been clearly demonstrated that significant heterogeneity between published studies precludes useful meta-analysis of results. Furthermore, the variability in reported injury data has been outlined. It remains the case that the true incidence of injury after sexual violence is unclear. It is however known that injury in itself significantly influences decision making at various stages of the criminal justice system from the decision to report to the decision to sentence.<sup>27</sup> Thus it is recommended that further primary observational research, with a clear focus upon collecting injury data, should be carried out. Large, high quality studies which utilise examination techniques that reflect clinical practice are needed. Furthermore, it is suggested that development of a mutually-agreed research protocol, to be used by future researchers at different institutions and in different countries, would enable results of small individual studies to be combined. A benchmark paper that outlines a robust process for conducting research on injury prevalence would be a useful contribution to the literature in this area. A similar suggestion resulted from the systematic review of published research evidence pertaining to examination findings in suspected child sexual abuse published by the Royal College of Paediatrics and Child Health.<sup>34</sup> The authors identified “an urgent need for well-conducted primary research studies in the UK where data are prospectively collected following a standardised protocol on children being evaluated for the possibility of CSA”.

## 6. Conclusions

The broad range of reported prevalence for injury after sexual violence is explained by the differences between study methodologies. The existing literature pertaining to the prevalence of injury after sexual violence is insufficiently homogenous to allow pooling of results. Clinical heterogeneity, in particular, precluded statistically robust meta-analysis.

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### Conflict of interest

None declared.

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